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ABSTRACT

This study developed a systematic approach for examining effects of policy decisions on student outcomes and assessed collective bargaining's impact on public school effectiveness and cost. Teacher unions' influence was gauged by modelling the educational process and examining responses of teachers, students, and administrators to the education and bargaining environment. Data from over 200 districts indicate that unions alter the way schools are run. Unionized teachers teach smaller classes, rely more on traditional instruction, and spend slightly less time in instruction, but more time preparing. Nonetheless, the overall quality of education as measured by scores on standardized tests is about the same in union and nonunion districts. Bargaining does appear to reduce achievement gains slightly for atypical students because specialized instructors or modes of instruction are more common in nonunion districts. Bargaining also increases the cost of providing a given quantity and quality of education by about 15 percent. (Author/KS)

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THE EFFECTS OF TEACHER COLLECTIVE BARGAINING ON STUDENT OUTCOMES

by

Randall W. Eberts and Joe A. Stone

June 1984

Center for Educational Policy and Management
College of Education
University of Oregon
Eugene, Oregon 97403
(503) 686-5173

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ABSTRACT

In this study, we accomplished two basic objectives. First, we developed a systematic approach for examining the effects of policy decisions on student outcomes when the analysis involves large numbers of schools. Second, we used this framework to assess the impact of collective bargaining on both the effectiveness and cost of public schools in the United States. The influence of teacher unions was gauged by modelling the educational process first, and then by examining the responses of teachers, students, and administrators to the education and bargaining environment. In our research, we used data for individual students and teachers from over 300 districts nationwide. The results indicate that unions do alter the way schools are run. Unionized teachers, for example, teach smaller classes, rely more exclusively on traditional classroom instruction, and spend slightly less time in instruction, but more time preparing for classes. Despite these and other differences, however, the overall quality of education, as measured by the scores of average students on standardized tests, is about the same in union and nonunion districts. Collective bargaining does appear to reduce achievement gains slightly for atypical students, students significantly ahead or behind the average. This appears to occur because specialized instructors or modes of instruction (such as specialists, aides, tutors, or independent study) are much more in common in nonunion districts. Our investigation of district operating costs indicates that collective bargaining increases the cost of providing a given quantity and quality of education by about 15 percent.

INTRODUCTION

In the face of the complex problems currently facing public education, administrators need to know more about the effects of factors such as declining enrollments, school closures, school size, and collective bargaining on student outcomes in order to make well-informed decisions. At present, very little is known about such macro effects on student achievement. Moreover, the framework for investigating these factors is not well developed.

With regard to collective bargaining, for example, almost nothing is known about how it has changed the effectiveness of schools, aside from the impact of collective bargaining on teacher salaries (see Baugh and Stone 1982a). McDonnell and Pascal (1979) note that despite "more than 15 years of experience and speculation about teacher collective bargaining, very little systematic research exists on its effects...What is available is a collection of untested assertions and anecdotal evidence." Cresswell and Spargo (1980) point out in a recent survey of the effects of collective bargaining that no one has systematically studied the overall effect of collective bargaining on the effectiveness of teachers or on student outcomes. With respect to school size, some research has suggested that student achievement is greater in smaller schools (Coleman et al. 1966; Summers and Wolfe 1977). However, researchers are only beginning to investigate why this may be true. With the widespread closure of schools due to declining enrollments and budget problems, much more than cost information is needed in order to understand the consequences of this action.

We contend that only a careful integration of the various determinants of student achievement with policy decisions and institutional structure will produce meaningful and substantive information about the relationship between these issues and student achievement.

The research contained in this final report accomplished two basic objectives. First, we developed a systematic approach for examining the effects of policy decisions on student outcomes. This was achieved by incorporating into the educational production function the behavioral responses of teachers, administrators, and students. Second, we used this framework to investigate two important institutional issues facing public schools: the growth of collective bargaining and the importance of school size. Prior to this research, adequate data bases were not available to give researchers the opportunity to investigate both the basic learning process and analyze policy issues simultaneously. The findings reported here, therefore, are the first attempts at systematically assessing the effect of collective bargaining on student achievement.

The report is organized in the following manner. Chapter One develops the educational production function model with specific emphasis on using it to estimate the effect of collective bargaining on student achievement. Nonetheless, the general applicability of the model to assess effects of other institutional changes is demonstrated by estimating the general model for fourth grade math achievement using data from a national sample of school districts. [Section Two examines collective bargaining by using production function framework.]

CHAPTER ONE: A MODEL OF STUDENT ACHIEVEMENT AND ITS APPLICABILITY TO ASSESSING THE EFFECTS OF COLLECTIVE BARGAINING

Most Americans believe that the success or failure of their children's education depends upon classroom teachers. It is not surprising, therefore, that when teachers unionize and are perceived by some to switch from the role of a dedicated classroom teacher to that of a dedicated union member, concern is expressed about how this will affect the quality of education. Although much energy has been devoted to debating and speculating about the effects of collective bargaining on American education, most research has looked at effects related to the immediate consequences of the bargaining process. Studies have examined the effect of teacher collective bargaining on class size, teacher salaries, and fringe benefits, teacher attitudes, teacher time, administrative leadership, and district organization. In addition, research has examined the dynamics of the bargaining process and the characteristics of the participants involved in shaping the agreements.[1] Nonetheless, nowhere in this volume of work is a study that relates collective bargaining directly to student outcomes.[2]

The absence of such a study does not reflect a lack of interest in the overall effects of teacher collective bargaining on teacher effectiveness. On the contrary, most studies that deal with one of the immediate consequences of collective bargaining try to make some link to student achievement, and most researchers acknowledge the importance of making this link.

The obvious question, then, is, Why are we still waiting for such a study to be performed? We offer two answers. First, since the effects of collective bargaining on student achievement are by-products of negotiations over teacher salaries and working conditions, many researchers dismiss the

significance of the ultimate effects on student achievement. For example, Mitchell and Kerchner (1981) and their colleagues contend that bargainers for both sides are so concerned with the immediate problems and consequences of the negotiations that they fail to gain a perspective on the effect of their decisions on the overall pattern of public education. It is also argued that since the issues considered at the bargaining table do not explicitly address teacher effectiveness, such matters are not, in fact, affected by the bargaining outcomes. Both observations lead to the conclusion that, since the consequences of collective bargaining on student outcomes are neither immediately apparent nor addressed during bargaining, these 'incidental' effects should be ignored.

Other researchers take a different stand on the incidental effects of collective bargaining. McDonnell and Pascal (1979), for example, accept the premise that teacher collective bargaining can affect students, but they recognize the complexity of linking bargaining outcomes to student outcomes. They report that

> Students experience the effects of bargaining only indirectly and occasionally. They may attend somewhat smaller classes, but for fewer hours per day and fewer days per year. Rising personnel costs may result in less supplementary learning resources for students, but at the same time teachers may be happier and aides and specialists more plentiful. An older and more highly credentialed teacher force may mean more expertise in instruction, but perhaps less flexibility and energy. How any of these consequences of collective bargaining influence the rate of learning or other student interests remains largely unknown.[3]

In a more recent statement about linking bargaining to students, McDonnell states that "it is much too early to try to tie collective bargaining outcomes to the effective school research".[4]

McDonnell's statement leads us to our second answer. Teacher effectiveness research is not sufficiently refined to detect the intricate and subtle effects collective bargaining may have on the education process.

The past two decades of research in teacher effectiveness has provided very little consensus regarding the contribution of school resources to student achievement. Educational production functions have been plagued by three basic problems. First, and foremost, the models did not address the question of how resources are allocated in school systems. Without this specification, behavioral responses of teachers, students, and administrators were not taken into proper account. Second, the time teachers and students spend on learning activities has only recently been identified as an important ingredient in the production process (Thomas 1979) and, consequently, only recently has been incorporated into the analysis. Third, adequate data were not available to give researchers the opportunity both to investigate the basic learning process and to analyze policy issues.

We have been able to overcome some of the difficulties that have plagued past studies, particularly as they apply to evaluating the effects of collective bargaining. First, we have acquired a database with student-specific information, school and district level characteristics, and information on bargaining outcomes. With this comprehensive database, we can trace the effects of collective bargaining from the negotiating table to the classroom. Second, the use of process variables, such as the time teachers and administrators spend on various activities, better enables us to focus on the determinants brought to bear on student achievement and which are immediate consequences of collective bargaining. By observing school districts at work at all levels of operation--classroom, school building, and district--as well as the behavioral responses of teachers to different institutional arrangements, one can examine the effects of teacher collective bargaining on student achievement.

The chapter is divided into two sections. The first section discusses the educational production function literature and reviews findings

from previous research on teacher effectiveness in an attempt to identify factors that are considered significant determinants of student achievement. The second section describes our own attempt at estimating an educational production function using data from a national survey of schools. Our estimation differs from past studies by including principal leadership variables and by entering teacher time explicitly into the achievement gains equation. In addition, we are able to rank the importance of key educational inputs. Assessing the relative importance of the various inputs will aid in determining the effect of teacher collective bargaining on student achievement as discussed in Chapter 2. At the end of this chapter, we provide a brief summary of the important determinants of student achievement and the potential effects teacher collective bargaining may have on these inputs, and thus on student achievement.

I. Measuring the Effects of Collective Bargaining on Student Achievement

Teacher contracts are negotiated by the district; students are educated primarily in the classroom. To establish a link between collective bargaining outcomes and student achievement, it must be shown that the consequences of negotiations are felt in the classroom. Bargaining outcomes enter the classroom primarily through their effects on teachers. Negotiations can affect class size; the time teachers spend on instruction and preparation; the number of administrative and clerical duties required of teachers', teacher attitudes; the age, experience, and educational composition of the teaching force; administrative leadership, and classroom organization. Unlike previous studies, which concentrate on these direct effects of collective bargaining, we go one step further. We consider the link between teacher collective bargaining and student achievement. We perceive this to be a two-step procedure. The first step is to determine the

importance of teacher, student, and organizational characteristics on student achievement. Once the significant factors have been identified through the use of an educational production function, the second step is to identify the direct effects of collective bargaining on the quantity and quality of these factors. Combining both steps, then, shows the paths through which collective bargaining can affect student achievement.

The remainder of this chapter considers the first step--identification of the major determinants of student achievement. We discuss the educational production function literature and review findings from previous research on teacher effectiveness in an attempt to identify which factors are considered significant determinants of student achievement. In addition, we offer an educational production function and generally apply it to results from data that we also used specifically to analyze some of the direct effects of collective bargaining.

A. Educational Production Functions

A large number of quantitative studies that relate school resources to student achievement have appeared over the last twenty years.[5] Although these studies are referred to by different names--input-output, teacher effectiveness, school effectiveness, or educational production functions--they share a common methodology. Murnane (1981), in a recent critique of this literature, characterizes these studies as multivariate analyses of the variation in student outcomes explained by variations in school resources. Furthermore, the variations in resources are created by the operation of a school system, not by a controlled experiment. The analysis is a "snapshot" of the school system at work. The key parts of the snapshot are information on the school resources that children receive at a given time and one or more measures of student progress.

Research on educational production functions asks the basic questions (1) Do schools matter in explaining student achievement? and (2) If so, what school resources are important in the educational process? First attempts at answering these questions produced results both surprising and unsettling to the education profession. The Coleman Report (1966) was perhaps the largest, most comprehensive, and most hotly debated study to emerge from the early attempts at estimating an educational production function. The study attempted to determine the school and nonschool factors related to the achievement of over 600,000 students across the country. The findings showed very little association between school inputs and student test scores; in other words, schools do not matter.

In spite of the findings of the Coleman report, however, currently, the general consensus of researchers is that schools do matter. The change in opinion is due to a number of advances in conceptualizing the educational process and in estimating the production function. First, researchers have learned the importance of using the individual child as the unit of observation rather than using school or district aggregates. Utilizing student-specific information, and at the same time identifying the school resources that each student actually receives (rather than using average resources present in the school or district), provides a much stronger link between inputs and outputs. Second, measures of school resources and student achievement also have changed since the Coleman Report. Early studies focused on the physical capital aspects of schools such as libraries, laboratories, and number of textbooks. Since then, the definition of resources has expanded to include teacher characteristics, classroom organization variables, measures of teacher quality, and time-on-task. The use of time-on-task variables has proven especially significant since they measure the actual flow of services between teacher and student rather than

the stock of potential services. Third, researchers also have recognized the importance of considering gains in student achievement rather than the levels of achievement. This approach accomplishes two things. It permits the researcher to "difference out" characteristics of students and teachers that do not change significantly over time but that affect the level (but not the gains in) of student achievement. In addition, by looking at achievement gains, the researcher can account for the effect of those resources that have influenced student achievement over a given school year, rather than capturing the cumulative effect of past years of schooling.

Although studies differ in their assessment of the relative importance of school resources in the educational production process, most agree that teachers are the critical resource in schools. One must be aware, however, that no research can claim unequivocally that certain resources actually cause instructional effectivness. Nor can any one rank resources or characteristics of effecective schools according to importance.[6] From the perspective of assessing the impact of teacher collective bargaining on student achievement, the second difficulty is the more troublesome. Since collective bargaining affects numerous educational determinants, it is necessary to know the relative contribution of these determinants in order to derive an overall assessment of the influence of collective bargaining. However, it is not possible to rank the importance of school resources by comparing findings from different studies. Estimates obtained from using regression analysis are sensitive to the measurement of variables and the specification of the model. Since studies differ considerably on these two points, estimates are not comparable. It is possible, on the other hand, to rank the importance of variables within a specific study. We proceed, therefore, to specify an educational production function, to discuss the findings of a number of past studies, and then to use what we have learned

from these to estimate an educational production function using a database that we will then also use in analyses of the effect of collective bargaining on student outcomes.

Basic Model

As previously mentioned, specifications of educational production functions differ among studies and thus it is impossible to capture with one specification all the features of all the models constructed to date. However, most studies share the features described by equation (1.1) which is borrowed from Hanushek (1979).

$$(1.1) \qquad A_{it} = f(B_{it}, P_{it}, S_{it}, I_i)$$

where

A_{it} = student outcomes of ith students at time t,

B_{it} = vector of family background influences of ith student cumulative to time t,

P_{it} = vector of influence of peers of ith student cumulative to time t,

S_{it} = vector of school inputs of ith student cumulative to time t, and

I_i = vector of innate abilities of ith student.

The model incorporates a number of essential aspects of the educational process. First, inputs are those that are relevant to the individual student. Second, the inputs are cumulative, which reflects the fact that schooling and other experiences in past years have a bearing on student outcomes in the present period. Third, school inputs include purchased (such as teachers) as well as nonpurchased inputs (such as peer groups). Fourth, the allocation of resources is predetermined from the perspective of the production function.

A somewhat popular variant of the model, and one that requires substantially less data collection, is the value added model. Instead of considering the contribution of past inputs on student outcomes, this specification considers the changes in student outcomes between two time periods, usually the beginning and end of a certain school year. This formulation reduces the data requirements, since inputs are collected only over the same two year period. The value added model results from simply subtracting (1.1) for period t^* from (1.1) for period t.

$$(1.2) \qquad A_{it} = F^*(B_i(t-t^*), P_i(t-t^*), S_i(t-t^*), I_i, A^*_{it})$$

Student outcomes in the earlier period (A_{it}^*) may be reflected in scores from pretests taken by students at the beginning of the school year. These scores are then compared with scores of tests taken at the end of the school year. In this way, the gains in student outcomes attributed to a flow of educational services within a given time period can be assessed.

Given the basic structure of the model, the next task is to describe the variables used to estimate the production function. We first consider the dependent variable and then proceed to discuss the independent variables used by various studies, including our own study, and to report the general findings associated with these variables.

Standardized Test Scores

Education begins with a student who brings unique attributes to the classroom and transforms that student into someone with different qualities. Educational production functions relate differences in the qualities of students to differences in school resources received by students.

In most of the studies considered under the rubric of educational

production functions, standardized test scores of cognitive skills are used as the measure of student outcome. Of course, test scores are not intended to measure all the attributes of education. School outcomes encompass, in addition to the acquisition of skills, conveyance of social norms, development of creative skills, and the provision of custodial services. A few studies have considered student attributes other than test scores as dependent variables. For example, Levin (1970), Michelson (1970), and Boardman, Davis, and Sanday (1977) considered student attitudes; Katzman (1971) looked at attendance rates; and Katzman (1971) and Burkhead, Fox, and Holland (1967) used college continuation and dropout rates.

These are all sensible measures. The decision of the vast majority of studies to use cognitive test scores results from a combination of availability and a certain conceptualization of education. Most school districts administer some form of standardized tests. Even though there is considerable controversy over what these tests actually measure, educators tend to believe that they are important. Performance on tests is used to advance students through the educational system, evaluate programs, and even to allocate funds. Further, it appears, given the recent concern over declining SAT scores, that interest in test scores is increasing.

Whether standardized tests reflect the value of education is still open to debate. A perspective on education useful in discussing the merits of standardized tests is offered by Hanushek (1979). He sees the value of education as relating to the "perceived importance of school in future capabilities" (p. 355). Future capabilities can include performance in the labor market, participation in the political system, and achievement in future educational endeavors. Considerable work has been done in linking educational achievement to these topics, particularly to the first one. Economists have analyzed the influence of education on earnings and labor

market performance [see, for example, the reviews by Mincer (1970) and Rosen (1977)]. Other researchers have explored the effects of schooling on occupational choice, mobility, and earnings, and the relationship between schooling and personal and family characteristics.[7] Although the direct links between formal education and such things as earnings and occupational choice, have yet to be unambiguously identified, it is agreed that education, at least in the basic skills, is important in the future performance of individuals.

B. Past Findings of Determinants of Student Achievement

It is difficult to compare results of past studies due to the many inconsistencies in the way the models are specified. Studies differ in the way the dependent variable is measured and in how it is entered in the regression analysis. Although most studies use standardized test scores, the scores are not comparable in many cases, and a change in the score of one test is not equivalent to a change in another test. Also, some studies use achievement levels while others use achievement gains. Inconsistencies also appear in the types of explanatory variables included in the production function. While it is implicitly assumed that educational models include all of the relevant variables and that they are measured accurately, this usually is not the case. Omitting important variables causes the estimates of the production function to be biased. Thus, even if the same database were used in all studies, it is highly probable that models including different combinations of variables would yield different estimates for the same coefficients. Despite these problems with comparing the results across studies, a judicious interpretation of the findings is useful in understanding the nature of the educational production process, that is, the robustness of results across all studies.

Murnane (1981), in critiquing the past literature on teacher effectiveness, has identified four groups of factors that have been shown to significantly affect student test scores: (1) student characteristics, (2) teacher characteristics, (3) time in instruction, and (4) curriculum and mode of instruction. However, he cautions that these groups should not be treated in parallel fashion. Rather, teachers and students are the primary resources and curriculum and mode of instruction can be seen as secondary resources that affect student learning through their influence on the behavior of teachers and students. Furthermore, the relationship between primary inputs and student outcomes is sensitive to the incentives and constraints placed on teachers by the school district. Thus, institutions, such as teacher collective bargaining, can have a major impact on the educational process by affecting both the money spent on secondary resources and the motivation, attitudes, and quality of the primary resources. In reviewing the findings related to these four groups of determinants, it is important to keep in mind the possible connections between teacher collective bargaining and these factors.

Teachers

Murnane (1981) reports that virtually every study of school effectiveness finds that some attribute of teachers is significantly related to student achievement. Studies have found that teachers with some experience are more effective than teachers with no experience. A teacher's performance on verbal ability tests and the quality of the college the teacher attended are both positively related to student test scores. Teachers with high expectations for their students are effective in helping children acquire cognitive skills.

A somewhat surprising result uncovered by many studies is that

teachers with master's degrees are no more effective, on average, than teachers with only bachelor's degrees. Murnane attributes these findings to teacher motivations. Before salary schedules were based on educational attainment, only teachers desiring additional education sought higher degrees. Now that a majority of teachers have advanced degrees either for the purpose of salary increases or to meet state certification requirements, the possession of a master's degree no longer signals a difference in effectiveness.

Mode of Instruction

We include under this category characteristics of the organization of the classroom that may affect student achievement. One of the most thoroughly researched factors in this group is class size. Perhaps one of the reasons that class size has received so much attention is that, in addition to being a highly visible indicator of teacher-student interaction, it subsumes a number of complex and perhaps competing microeffects. For instance, class size can be considered a measure of the amount of time the teacher interacts with students. Larger class sizes introduce congestion, and the teacher must spend either more time with the whole group or less time with individual students. Class size also may reflect the organization of the classroom. A study by Glass and Smith (1978) shows that the size of the instructional unit has a significant effect on the achievement levels of students. Using meta-analysis to synthesize the results of past studies, the authors show that as the size of the instructional unit increases from 1 to 20 students, the achievement levels of students dramatically decrease, falling by over 20 percentile rankings. For class sizes greater than 20, an increase in enrollment has very little effect on achievement.

The reasons behind the conclusions regarding class size are rooted in

the dynamics of the interaction between student and teacher. One important measure of this interaction is the time spent in instruction. Recent attention to this determinant has produced encouraging results. Several studies report systematic relationships between time and student achievement.[8] Another dimension of class size is its effect on the instructional strategies that can be employed in the classroom. The ability to provide students with individualized instruction or to work in small groups depends upon the number of students for which the teacher is responsible. If the group is large and the teacher does not have the assistance of an aide, the numbers of instructional arrangements possible are reduced. In principle this interaction between class size and instructional strategy can be investigated, but due to the lack of reliable information on instructional strategy, the analysis has been limited to small samples.

Class size contains a third dimension. Except in individualized instruction, teachers interact simultaneously with most of the students in the classroom. In this sense, the teacher's time is equally shared by all students. However, since students are characterized by different learning abilities and home environments, the common time the teacher spends with students influences each student differently. Thus, the consequences of a large class may not affect by all students in the class equally. A comprehensive analysis of this effect would require interacting student characteristics with class size, but this is rarely done due to the large data requirements.

Peer Groups

Another aspect of classroom interaction is the effect of classmates on a student's achievement. Henderson, Miezskowsk, and Sauvageau (1978) and Summers and Wolfe (1977) provide evidence that elementary school children

with low initial skill levels who attend schools in which the average achievement level is relatively high make more progress than such children who attend schools in which the average achievement level is relatively low. Winkler (1975) shows that the same is true for students of different socioeconomic backgrounds. The issue of the effect of the composition of the student body on achievement levels received considerable attention when school desegregation and integration were important issues. From the standpoint of collective bargaining, however, peer groups have little importance, since teachers have little control over the types of students who enter their district.

Administrative Leadership

Currently there is much debate about the potential of administrative leadership to increase student achievement. While instructional leadership has been defined in a variety of ways, we will generally use this term to include activities such as program evaluation, supervision and support of teachers, and curriculum development and coordination. A number of studies has provided evidence that administrative leadership is indeed a promising area for research relating to school improvement. For example, Keeler and Andrews (1973) find that the leadership behavior of the principal, as perceived by his staff, was significantly related to school productivity (Miller 1976, p. 337). More recently a number of other researchers have provided corroborative evidence in support of the hypothesis that school principal involvement in instructional leadership is correlated with improved student outcomes (Edmonds 1979, Brookover and others 1979, and Wellisch and others 1978).

While the studies noted above support the notion that principal involvement in instructional leadership leads to school improvement, others

have informed us that principals who actively engage in such activities are indeed rare (Deal and others 1975, Lortie 1969, Corwin 1970, Cohen and Miller 1980). Moreover, even researchers who accept the notion that instructional leadership is linked to school improvement have asserted that it is not the principal who is important per se, but rather that there are critical support functions that must be carried out. These support functions may be performed by a variety of school personnel other than the principal--curriculum specialists, department heads, and teachers (Gersten and Carnine 1981, Pitner 1980). Finally, still others caution that even when principals engage in the comprehensive set of tasks referred to as instructional leadership, the participation of teachers also must be considered as a critical ingredient (Wellisch and others 1978).

If administrative leadership is important to student achievement, what elements of administrative behavior are most important? Although an important role of the principal is to provide instructional leadership, very little of the principal's time is spent in any instructional interaction with students. The time the principal does spend with students is either when disciplining them or when observing and evaluating teachers in the classroom. The effect of principals on student achievement primarily comes through various interactions with teachers. The potential effect of this interaction can be understood best by considering what the ideal role of a principal should be. Work previously cited by Edmonds, Cohen, Brookover, and Gersten and Carnine, to mention a few, identifies a number of ways in which the principal can enhance educational programs. These elements include (1) maintaining order, (2) acting as an agent of change, (3) setting clear objectives, (4) conveying high expectations of student achievement, (5) offering support and guidance to teachers, (6) providing public rewards and incentives, and (7) spending time in the classroom. These activities have

not yet been entered in any systematic way into the educational production functions. We attempt to examine the effect of certain aspects of principal leadership in our analysis reported in the next section.

From the characteristics of a successful administrator listed above, it is clear that the effectiveness of administrative leadership is contingent on close cooperation and shared goals between teachers and principals. The net effect of teacher collective bargaining on the educational program through the effectiveness of principals is closely tied to the posture that teachers and principals take when forced to choose sides at the negotiating table. The positions taken by principals are unclear, as indicated in the conflicting observations of a number of case studies. Griffin (1974) reports that some teachers' representatives see the principal as the person most knowledgeable of the needs, abilities, desires, and effectiveness of the teachers in his/her other school. The principal, therefore, makes an excellent ally. Griffin, on the other hand, finds that the fear of "administrative coercion" serves as a primary deterrent for not including the principal on the teachers' negotiating team. Perry and Wildman (1970) and Cooper (1982) find that building principals, by being squeezed between the very vocal demands of central administration and teacher unions, feel alienated from the decision-making process and may even opt for their own union.

The pertinent question regarding the effectiveness of building administrators is whether they have lost their role of instructional leader by losing the power to administer policy at the school level. A conclusive answer has not been found. Randles (1975) expressed the views of some researchers who believe that contracts give principals more legitimacy in enforcing contractual provisions than they formerly enjoyed. Nicholson and Nasstrom (1974) note that principals who functioned under collective

bargaining contracts "tended to make more decisions exclusive of central office involvement." They attribute this to the fact that the formalized procedures outlined in contracts allow principals more freedom from central office interference in decision-making.

Although contracts may give building principals certain freedom from the central office, principals also must stay within the bounds set out by the contract. Brandsletter (1970) and Nicholson and Nasstrom (1974) found that principals perceived negotiated contracts as having curtailed their supervisory authority in such areas as teacher transfer and evaluation, scheduling, and determining program level and subject matter. These same authors, however, conclude that "negotiations per se have not necessarily reduced authority, but instead have required a redefinition of the parameters of authority."

II. Analysis of the Determinants of Mathematical Skills

Some of the variation in the results found in the literature may be due to different data sets used in the analyses. Thus, in order to analyze the effect of collective bargaining on achievement scores, the comparative must be based on the same data set. We use a database containing information that can accommodate both an estimation of an educational production function and an analysis of union effects. The database was constructed by the Systems Development Corporation under contract with the Office of Education for the purpose of assessing the costs and benefits of compensatory education. Since no one has used the data to estimate an educational production function of the form presented in Section B, we have undertaken the task and present the methodology and results in this section.

The basic model chosen for this study is the achievement growth model described in equation (1.2). An achievement growth model explains the gains

in student achievement due to changes in educational resources the student receives over a given time period. The model that we estimate is slightly different from the model presented previously. Due to our concern with the effects of collective bargaining, we have restricted a priori the explanatory variables to those that may be affected by collective bargaining. Of course, certain variables, such as student characteristics, are included in the analysis in order to control for their effects on student achievement.

A. Description of the Data

The database contains data on mathematics and reading programs for 328 elementary schools selected randomly nationwide. In this chapter, however, we consider only the math scores of fourth graders. In the next chapter in which we analyze the effects of collective bargaining on student achievement, sixth grade math norms are also considered. We look at math scores because we feel that, since students receive less math than reading instruction at home, gains in math skills should be associated more directly with school activities. The sample contains observations on over 14,000 fourth graders enrolled during the late 1970s. Five general categories of variables were collected: achievement growth in mathematics for each student; measures of the individual student's background; characteristics of the student's math classroom teacher for the year; the amount of time the teacher spent in instruction, preparation, and administrative duties; and characteristics of principals, including leadership activities and qualities. The achievement growth measure was based on two tests. At the beginning of each school year, an at-level test was given to assess the student's mastery of certain mathematical skills acquired up to that time. At the end of the school year, a similar test, asking questions with the same level of difficulty as were asked at the beginning of the year, was administered to

determine the gain in skills over the year.[9] The achievement growth measure then captures the increase in skills attributable to resources received during the school year.

The student background measures include age, sex, race, childhood educational experience, parental involvement, exact grade level, and economic status of the student. Teacher characteristics include teaching experience, highest degree earned, college courses taken in mathematics in the last three years, hours of math inservice in the last three years, and the amount of time given to preparation for class.

Three categories of teacher time are included in the educational production function. Two categories, time spent in instruction and time spent in preparation, are expected to positively influence student achievement gains. The third category, time spent performing administrative and clerical duties, which includes attending staff meetings, is expected to have a negative effect. Although time spent in total instruction is not the same as time spent in math instruction, we find that the two activities are highly correlated and thus total instruction is a good indication of the flow of teacher services received by the student. These time groups account for 90 percent of the time the average teacher spends in school-related activities.

Characteristics of principals--experience in teaching, experience as a principal and highest degree earned--were also included in the production function. Also available were measures of the level and quality of principal instructional leadership. Two types of variables were considered. The first set of variables records the amount of time principals spend in activities related to math curriculum development and needs assessment, planning math programs, and evaluating these programs. The second set reflects teachers' and administrators' assessments of the effectiveness of certain leadership

activities and how well the staff works together. Teachers and principals were asked if they strongly agree (value=4), agree (value=3), disagree (value=2), or strongly disagree (value=1) with the following questions: (1) School programs are well planned and clear; (2) principal provides active leadership to math programs; (3) teachers in this school work well together; (4) administrators keep teachers well-informed; (5) conflicts among individuals are identified and faced, and not allowed to fester. By having the responses to these questions from both teachers and administrators, it is possible to check whether an individual's own assessment of his or her actions is more accurate than someone else's assessment.

District-level variables measuring the staff to student ratio also are included in the analysis. Class size, as approximated by the teacher-student ratio, has been used extensively to reflect the flow of teacher services. Although we have a direct measure of the flow of services in the instructional time variable, it is useful to include class size in order to reflect characteristics of the organization of the classroom. In like manner, the number of administrators per student is included to capture certain features of the organization of the district.

B. Results

The achievement-growth model, described in equation (1.1), is estimated using ordinary least squares. All the variables discussed in the previous section, however, are estimated simultaneously. For ease of discussion, the results are grouped by categories and displayed in Tables 1.1 through 1.4. The estimates are encouraging on two counts: first, they are consistent in most regards with past studies and second, they appear to uncover relationships not previously found between teacher time, principal leadership characteristics, and student achievement. By reporting

standardized betas instead of the parameter estimates, we are able to compare the relative importance of each input in explaining the gains in student achievement.[10]

Although we are primarily concerned with school-based variables that can be influenced by teacher collective bargaining, a number of student background variables are included in order to control for the aptitudes, motivation, and home experience students bring to the classroom. The coefficients of these three control variables are shown in Table 1.1. Only parental involvement and economic status are statistically significant. A comparison of the standardized betas associated with these two variables reveals that an increase of one standard deviation in the student's economic status contributes over six times more to student achievement gain than does an increase of one standard deviation in parental involvement. The sex and ethnic origin of students are significantly related to achievement gain. Although white students appear to have higher achievement growth than nonwhites, this may be due to the importance of omitted variables such as language barriers and family background, and we do not venture any interpretation of this variable. It is included only to control for student backgrounds that are difficult to quantify.

The pretest score, from a math test administered in the fall is entered both linearly and as a squared term. The combination of the two variables allows for the possibility that the relationship between the pretest and posttest may be nonlinear. For example, nonlinearities could occur due to the fact that each test has a finite number of questions, and students who began the school year with a higher test score would be less likely to make significant gains than students who began the year with much lower pretest scores. Since the coefficient associated with the squared pretest score is insignificant, the relationship between pretest and posttest

TABLE 1.1 Effect of Student Background Measures and Pretest Scores on Fourth Grade Math Scores

	VARIABLE DESCRIPTION		COEFFICIENT	MEANS
1)	SEX (Male = 1)		-.074 (13.29)	.5023
2)	RACE (White = 1)		.051 (7.94)	.7292
3)	CHILDHOOD EXPERIENCE		.00002 (.004)	1.0529
4)	PARENTAL INVOLVEMENT		.016 (2.73)	1.8772
5)	ECONOMIC STATUS		.107 (16.32)	224.9576
6)	PRETEST	STD BETA BETA	.665 .89 (24.27)	28.671
7)	PRETEST SQUARED	STD BETA BETA	-.014 -.0003 (.05)	915.914
N			14,882	
R^2			.55	
F			521.1	

NOTE: All variables included in Tables 1.2 to 1.5 were estimated simultaneously. Coefficients expressed as standardized betas; t-statistics in parentheses.

scores is linear. The magnitude of the regression parameter indicates that an increase of one point on the pretest increases the posttest score by about nine-tenths of a point, when everything else is held constant.

Most studies have found that teacher experience and highest degree attained by teachers are significant determinants of student achievement. Our results reinforce this conclusion. Teachers with more experience are more effective in raising student achievement levels, whereas teachers with more formal education appear to be less effective. For the negative relationship between education and achievement gain, Murnane (1981) offers the explanation that the motivation for additional college credit is less that of self-improvement than that of salary increase, which appears to be a counterproductive pursuit with respect to student achievement.

Also included as teacher characteristics are measures of teacher activities related to the math program. Results show that college-level courses related to teaching math do not contribute significantly to achievement gains. Moreover, staff development and inservice training related to math instruction appear to decrease achievement gain. In the same way, teachers who are encouraged by principals to try new teaching methods are less effective than teachers who do not receive such encouragement. It is difficult to explain these results. Some researchers in the instructional leadership field, however, find that when teachers receive only intermittent training or are not given the opportunity to follow up on new techniques or programs, very few positive results come from these activities (Gall 1983). A similar situation may be prevalent in the schools we studied. Another explanation may be that teacher involvement in inservice training is a distress signal, and the negative sign indicates that teachers taking these programs are initially below par.

As expected, the time teachers spend in instruction and in

preparation is positively and significantly related to achievement gains. Moreover, results in Table 1.2 show that time spent in instruction is almost twice as effective as time spent in preparation. Since time in instruction is an important indicator of the interaction between student and teacher, this result is important when assessing the way in which collective bargaining can enter the classroom.[11] As mentioned earlier, time spent in instruction includes instructional activities other than math programs. Variables reflecting the time students were engaged in math instruction also were available and were regressed against student achievement. Since these results did not differ significantly from the results reported in Table 3.2, we chose to use total instruction as the time variable. This tends to suggest what most educators already argue, that instruction has complementary effects on a number of areas.

The teacher-student ratio traditionally has been entered into educational production functions as a proxy for the amount of instruction received by students. Students in larger classes, even though they may spend the same amount of time with the teacher, may not receive the same level of instruction as a student in a smaller class, since the teacher's time is divided among a greater number of students. The teacher-student ratio, as reported in Table 1.3, is positively related to student achievement gains. This finding concurs with previous studies as well as with our own work, which classified instructional time by the size of the instructional unit.

The characteristics of principals produced results very similar to those found for teachers. Estimates displayed in Table 1.3 reveal that principals with more experience, either as a teacher or an administrator, are found to be more effective. Principals with more education, on the other hand, are less effective. As was found for teachers, time spent by principals on activities related to math curriculum development is associated

TABLE 1.3: Effect of Principal Measures and Staff Size on Fourth Grade Student Test Scores

	VARIABLE DESCRIPTION	COEFFICIENT	MEANS
1)	HIGHEST DEGREE ATTAINED	-.022 (3.88)	2.997
2)	EXPERIENCE TEACHING	.024 (4.20)	10.188
3)	TOTAL EXPERIENCE AS PRINCIPAL	.030 (5.23)	8.867
4)	TIME SPENT DURING SCHOOL YEAR IN ACTIVITIES RELATED TO MATH CURRICULUM DEVELOPMENT	-.015 (2.00)	9.760
5)	TIME DEVOTED TO NEEDS ASSESSMENT, PROGRAM PLANNING, AND EVALUATION FOR MATH PROGRAM	.036 (4.46)	11.876
6)	INSTRUCTIONAL LEADERSHIP (COMPOSITE INDEX)	-.015 (1.77)	53.528
7)	ADMINISTRATORS PER DISTRICT ENROLLMENT	-.019 (2.96)	.0039
8)	TEACHERS PER DISTRICT ENROLLMENT	.024 (3.73)	.0545
9)	CLERICAL STAFF AND AIDES PER DISTRICT ENROLLMENT	-.015 (2.42)	.0188

Note: Coefficients are standardized betas; t-statistics in parentheses.

TABLE 1.4: Effect of Attitudes of Principals and Teachers About Principal's Instructional Leadership on Fourth Grade Math Scores

VARIABLE DESCRIPTION		COEFFICIENT	MEANS
1) SCHOOL PROGRAMS WELL PLANNED AND CLEAR	P	-.013 (1.91)	3.249
	T	.005 (.73)	2.585
2) PRINCIPAL PROVIDES ACTIVE LEADERSHIP TO MATH PROGRAM	P	-.011 (1.61)	3.121
	T	.016 (2.35)	2.307
3) TEACHERS IN THIS SCHOOL WORK WELL TOGETHER	P	.012 (1.64)	3.432
	T	-.003 (.40)	2.994
4) ADMINISTRATORS KEEP TEACHERS WELL-INFORMED	P	.001 (.09)	3.373
	T	-.009 (1.30)	2.330
5) CONFLICTS AMONG INDIVIDUALS ARE IDENTIFIED AND FACED, AND NOT ALLOWED TO FESTER	P	.012 (1.73)	3.274
	T	.001 (.12)	2.279

NOTE: 'P' Designates principal's response to question.
'T' Designates teacher's response to question.

Coefficients are standardized Betas;
T - Statistics in parenthesis

with lower achievement gains. This result is offset, however, by an increase in achievement gains when time is devoted to needs assessment, program planning, and evaluation of the math program. A composite index of teacher responses to questions concerning the principal's instructional leadership is negatively related to student achievement gains, but it is not statistically significant at a reasonable confidence level. A curious result is that students in districts with higher than average administrators per student have lower achievement gains than students in districts with lower than average administrators per student. The number of administrators per student could be a reflection of certain district characteristics, which are not controlled for in the regression.

The final set of variables entered into the educational production function reflects the attitudes of principals and teachers about the principal's leadership and the cooperative nature of the staff. The interesting result emerging from the effects of these attitudes on student achievement gain is that in many cases self-assigned scores of teacher or administrator performance are inversely related to student achievement, whereas assessment by another party is related to student achievement in proper fashion. For example, both principals and teachers were asked to assess the principal's instructional leadership of the math program. When principals rate their leadership highly, student achievement gains are lower than otherwise. When teachers rate the same principals highly, however, achievement gains are in fact higher than otherwise. The same relationship occurs for assessments of the ability of teachers to work well together. A high rating by the principal is associated with achievement gains, whereas a high rating by the teachers has no significant relationship with gains in test scores.

Our estimates of the educational production function are basically

consistent with past studies. We find that class size and teacher experience are positively related to student achievement gains and that student background variables also are important determinants. Our results further reinforce the basic notion that the interaction between teacher and student, as measured by instructional time, is an important determinant of student achievement. In addition, quality-related teacher characteristics remain significant even when explicit measures of services flows are introduced. Including principal characteristics and activities related to instructional development, on the other hand, produces some curious, if not counterintuitive, results. The experience of principals, for example, is positively related to achievement gains. With regard to instructional leadership, however, only the time principals spend evaluating and planning math programs is positively related to student achievement gains. The other variables are either negative or statistically insignificant.

III. Conclusion

We began this chapter with the premise that in order for teacher collective bargaining to influence student outcomes, the effect of teacher collective bargaining must be experienced in the classroom. In this section, we determine which of those variables that are potentially influenced by collective bargaining are also significant determinants of student achievement. As one might suspect, a critique of past studies and our own analysis indicate that teachers and students are the primary actors in the educational process. The interaction of these two parties is affected by the allocation of resources and by the incentive mechanisms embodied in the institutional structure of school districts.

The findings point to a number of teacher- and principal-related factors that are important determinants of the educational process. Basing

the importance of the educational determinants on the magnitude of the standardized beta coefficients reveals the ranking of inputs displayed in Table 1.5. For those factors that contribute positively to achievement gains, the time principals spend assessing and evaluating math programs ranks first, followed closely by the time teachers spend in instruction. The next highest ranked determinants are related to the experience of principals. The teacher-student ratio is next, followed by the time teachers spend in preparation. Finally, teacher experience ranks last among the teacher and principal characteristics with significant effects on student achievement.

Of those factors negatively related to achievement gains, the effects of the highest degree attained by teachers and principals rank first and second, respectively. The number of administrators per student ranks third.

We conclude, therefore, that if collective bargaining affect these factors, especially the highest ranked factors, in significant ways, then collective bargaining will affect student achievement. The purpose of the next chapter is to explore how union-induced differences in the level of inputs and the structure of the educational production function affects student achievement gains.

TABLE 1.5: Ranking of Important Inputs into the Educational Production Function

INPUTS WHICH POSITIVELY AFFECT STUDENT ACHIEVEMENT GAINS

(1)	Time principals spend assessing and evaluating math program	(0.036)
(2)	Time teachers spend in instruction	(0.032)
(3)	Total experience of principals as administrators	(0.030)
(4)	Total experience of principals as teachers	(0.024)
(5)	Teacher/student ratio	(0.024)
(6)	Time teachers spend in preparation	(0.017)
(7)	Total experience of teachers	(0.013)

INPUTS WHICH NEGATIVELY AFFECT STUDENT ACHIEVEMENT GAINS

(1)	Highest degree attained by teacher	(-0.031)
(2)	Highest degree attained by principal	(-0.022)
(3)	Administrator/student ratio	(-0.019)

Note: Only school-related inputs were included in the rankings. Standardized betas in parentheses.

FOOTNOTES

[1]A partial list of studies includes (1) for class size, Hall and Carroll (1973), Chambers (1975), and Cresswell and others (1978); (2) for salaries and fringes: Baird and Landon (1972), Lipsky and Drotning (1973), and Kasper (1970); (3) for teacher attitudes; Balasco and Alluto (1974), Herndon (1976) and Lortie (1977) (although the latter two do not address unionization directly); for teacher time; Eberts (1983); and (4) for administrative leadership: Randles (1975) and Nicholson and Nasstrom (1974).

[2]Cresswell (1980), in a recent survey of the teacher collective bargaining literature, confirms our observation: "We found no studies which attempted to examine the question directly" (p. 60).

[3]McDonnell and Pascal (1979), p. xii.

[4]Comments taken from the Proceedings of a Conference on "The Effects of Collective Bargaining on School Administrative Leadership" held at the Center for Educational Policy and Management, University of Oregon, July 9-10, 1982, p. 41.

[5]Conn (1979), in his textbook The Economics of Education, lists no fewer than 65 specific production function studies. Undoubtedly, there are more. Four somewhat representative studies are Coleman (1966), Hanushek (1970), Murnane (1975), and Summers and Wolfe (1977).

[6]Edmonds (1982), p. 4.

[7]See Hanushek (1979) for a fairly extensive bibliography of these studies.

[8]See Wiley and Harnischfeger (1974), Fisher and others (1980), Monk (1980), and Thomas (1979).

[9]The tests that were administered were the "Comprehensive Tests of Basic Skills" published by CTB/McGraw-Hill. Scores from tests covering both mathematics concepts and computations were used.

[9]A standardized parameter estimate is a parameter estimate multiplied by the standard deviation of the associated regressor and divided by the standard deviation of the variable regressed. It can be interpreted as the increase in student achievement attributed to an increase of one standard deviation of the associated input. Since the magnitudes of all coefficients are in essence standardized by a uniform unit of change (i.e. one standard deviation) the magnitudes of the coefficients can be compared.

[11]Eberts (1983) reports that teachers covered by collective bargaining devote less time to instruction but more time to preparation than teachers not covered. If these were the only variables which were altered by collective bargaining we would conclude that collective bargaining decreases student achievement. Many other variables come into play, however, and we will take these into account in Chapter 2.

CHAPTER TWO: STUDENT ACHIEVEMENT AND COLLECTIVE BARGAINING

In this chapter we examine the overall impact of collective bargaining on both the level and cost of student achievement, thus providing a broad assessment of collective bargaining. In Section I, our analysis and measurement of the potential effects of collective bargaining on levels of student achievement are decomposed into three parts. First, we measure the effects due to induced changes in the levels of the various resources going into the educational process, that is, those determinants of student achievement emphasized in the previous chapter. Second, we measure the effects due to induced changes in the educational process, that is, differences in the educational production functions for the union and nonunion sectors. Third, we measure the effects due to interactions between the two types of changes, that is, between changes in resource and changes in process. This detailed decomposition enables us both to assess the net effects of collective bargaining on student achievement and to identify some of the sources of the effects. Moreover, our results provide evidence on the question of whether the impact of collective bargaining varies for different types of students. The effect of collective bargaining on math achievement of both fourth and sixth graders is examined. Including performance in both grades provides a way to check the consistency of our results.

In Section II, our analysis and measurement of the effects of collective bargaining on the cost of student achievement is distinguished from previous studies by the use of national data with detailed controls for student, district, community, and regional factors, but what sets it apart most significantly is the use of measures of student achievement to control for "quality" of education. Thus, we attempt to isolate the effect of

collective bargaining on the costs of providing a given quality and quantity of education. A final section summarizes our major conclusions.

I. Resources, Student Achievement, and Collective Bargaining

The objective of this section is to measure the impact of collective bargaining on levels of student achievement. If one views student achievement as being jointly determined by the levels of various resources (including individual student characteristics) going into the educational process and by the efficiency of these resources, then changes in student achievement can be decomposed into those resulting from changes in the levels of resources, changes in the efficiency of the resources (that is, changes in the educational process), and the interaction between the two types of changes. The sum of these three components approximates the actual change in student achievement.[1] We will first look at fourth grade math scores and then compare our results for this grade with results obtained for sixth graders.

A. Fourth Graders

Differences in Educational Inputs

Our analysis of educational production functions in Chapter 1 considered several dozen factors potentially important to student achievement. In this subsection we evaluate the impact on student achievement of induced differences between union and nonunion districts in the levels of these productive factors. To do this, we first compute the differences between union and nonunion districts for the factors considered in Chapter 1. These differences, along with the separate union and nonunion means, are presented in Table 2.1. Almost all the means differ significantly for the union and nonunion districts. Only the means for sex, race, the time

TABLE 2.1: Means of Education Inputs for Fourth Graders by Union Status (SDC Data)

VARIABLES	UNION MEANS	NONUNION MEANS	DIFFERENCE
Intercept	1.000	1.000	0.0000
Sex (Male=1) - Student	0.496	0.513	-0.0169*
Race (White=1) - Student	0.725	0.736	-0.0103
Childhood experience - Student	1.050	1.058	-0.0084
Parental involvement - Student	1.958	1.736	0.2223*
Economic status - Student	228.970	217.937	11.0328*
Administrators per student	0.004	0.004	0.0004*
Teachers per student	0.057	0.051	0.0060*
Office staff per student	0.018	0.020	-0.0014*
Teacher time in instruction	4.830	4.992	-0.1620*
Teacher preparation time	1.425	1.371	0.0538*
Teacher time in administrative duties	0.798	0.778	0.0199
Total years teaching - Teacher	12.359	11.334	1.0254*
Highest degree - Teacher	2.477	2.444	-0.0335*
College math courses - Teacher	0.630	0.566	0.0635*
Math inservice - Teacher	6.149	9.485	-3.3361*
Principals' leadership/Teachers' perception	3.516	3.347	0.1694*
Principals' encouragement/Teachers' perception	3.124	3.244	-0.1198*
Pretest score	29.077	27.961	1.1166*
Pretest score - squared	942.277	869.783	72.4938*
Highest degree - Principal	2.986	3.015	-0.0290*
Total years teaching - Principal	10.602	9.464	1.1378*
Total years administration - Principal	9.129	8.408	0.7206*
Math participation - Principal	10.2295	8.9398	1.2897*
Math involvement - Principal	12.1196	11.4505	0.6691*
Instructional leadership - Principal	53.4762	53.6173	-0.1411*
Attitudes:			
Well-planned - Principal	3.2050	3.3276	-0.1226*
Well-planned - Teacher	2.5423	2.6595	-0.1167*
Active leadership - Principal	3.1635	3.0456	0.1179*
Active leadership - Teacher	2.2340	2.4359	-0.2019*
Work well together - Principal	3.4545	3.3928	0.0617*
Work well together - Teacher	2.9493	3.0721	-0.1228*
Well-informed - Principal	3.3578	3.3989	-0.0411*
Well-informed - Teacher	2.2968	2.3893	-0.0925*
Conflicts identified - Principal	3.2256	3.3590	-0.1334*
Conflicts identified - Teacher	2.2237	2.3762	-0.1525*
Posttest score	39.6477	37.8411	1.8066*

*Significant at the .05 level
Notes: See Chapter One for a detailed description of the variables.

teachers spend performing administrative duties, and instructional leadership by the principal are statistically the same for the two sets of districts.

We are particularly concerned with differences for those factors identified in Chapter 1 as major determinants of student achievement in mathematics: teacher instruction time, teacher preparation time, teacher experience, teacher degree, principal involvement, principal experience in teaching, principal experience in administration, principal degree, teacher-student ratio, and administrator-student ratio. Teacher degree, principal degree, and the administrator-student ratio were found in Chapter 1 to be inversely related to student achievement--all the other factors were found to be positively related. As shown in Table 2.1, the union means exceed the nonunion means for all but teacher instruction time.

To assess the <u>net</u> effect of the difference in each educational input on student achievement, the impact of each difference in mean is calculated by multiplying each difference by the corresponding coefficient from the nonunion production function. Separate estimates of the nonunion coefficients are displayed in Table 2.2. The calculations are displayed in the first column of Table 2.3, under the column heading $\beta\Delta X$. The largest positive effects are those for economic status, teachers per student, math inservice training, and pretest score; the largest negative effects are for teacher instructional time and teacher perception of how well school programs are planned. The sum of all these individual effects is 1.52, about 15 percent of the average gain from the pretest to posttest score.

Many of the differences in means, however, are not actually induced by collective bargaining, so it is wrong to attribute all of the effects of the differences to collective bargaining. To get only those differences in means attributable to collective bargaining, we use the results found in Eberts (1982), where the relationship between collective bargaining and major

TABLE 2.2: Education Production Functions for Fourth Graders by Union Status (SDC Data)

VARIABLES	COEFFICIENTS UNION	NONUNION	DIFFERENCE
Intercept	11.71*	12.97*	-1.26
Sex (Male=1) - Student	-1.85*	-1.99*	0.14
Race (White=1) - Student	1.79*	0.98*	0.81*
Childhood experience - Student	-0.13	0.07	-0.20
Parental involvement - Student	0.13*	0.03	0.11
Economic status - Student	0.02*	0.02*	0.00
Administrators per student	-216.01*	-19.30	-196.70*
Teachers per student	17.28*	47.25*	-29.97*
Office staff per student	7.41	-26.56*	33.97*
Teacher time in instruction	0.35*	0.85*	-0.50*
Teacher preparation time	0.29*	0.64*	-0.35
Teacher time in administrative duties	0.14	-0.63*	0.77*
Total years teaching - Teacher	0.01	0.04*	-0.03
Highest degree - Teacher	-0.92*	-0.35	-0.57*
College math courses - Teacher	0.17	-0.08	0.26*
Math inservice - Teacher	-0.001	-0.32	0.32
Principals' leadership/Teachers' perception	-0.17*	0.17*	-0.33
Principals' encouragement/Teachers' perception	-0.42*	-0.15	-0.27
Pretest score	0.97*	0.71*	0.26*
Pretest score - squared	-0.00165*	0.0027*	-0.00435*
Highest degree - Principal	-2.27*	-0.29	-1.99*
Total years teaching - Principal	0.08*	0.02	0.05*
Total years administration - Principal	0.10*	0.13*	-0.03
Math participation - Principal	-0.05*	-0.00	-0.05*
Math involvement - Principal	0.02	0.09*	-0.07*
Instructional leadership - Principal	0.05*	-0.10*	0.16*
Attitudes:			
Well-planned - Principal	-0.43	0.20	-0.64*
Well-planned - Teacher	0.04	0.06	-0.01
Active leadership - Principal	-0.11	-0.84*	0.73*
Active leadership - Teacher	0.00	0.28*	-0.28*
Work well together - Principal	0.11	-0.82*	0.93*
Work well together - Teacher	-0.08	-0.07	-0.00
Well-informed - Principal	0.45*	0.40	0.05*
Well-informed - Teacher	0.00	-0.44*	0.45*
Conflicts identified - Principal	0.18	0.61*	-0.43
Conflicts identified - Teacher	0.19*	-0.17	0.36*
R^2	.5598	.5466	
No. observations	9470	5412	

*Significant at the .05 level.
Notes: See Chapter One for a detailed description of the variables.

TABLE 2.3: Effects on Fourth Grade Student Achievement of Differences Between Union and Nonunion Districts in Education Inputs and Education Production Functions

VARIABLES	$\beta \Delta X$	$X \Delta \beta$	$\Delta X \Delta \beta$
Intercept	0.000	-1.264	0.000
Sex (Male=1) - Student	0.034	0.072	-0.002
Race (White =1) - Student	-0.010	0.597	-0.008
Childhood experience - Student	-0.000	-0.209	0.002
Parental involvement - Student	0.006	0.183	0.023
Economic status - Student	0.165	0.259	0.013
Administrators per student	-0.007	-0.730	-0.073
Teachers per student	0.285	-1.519	-0.181
Office staff per student	0.037	0.670	-0.048
Teacher time in instruction	-0.138	-2.482	0.081
Teacher preparation time	0.035	-0.486	-0.019
Teacher time in administrative duties	-0.012	0.599	0.015
Total years teaching - Teacher	0.044	-0.343	-0.031
Highest degree - Teacher	-0.012	-1.387	-0.019
College math courses - Teacher	-0.005	0.145	0.016
Math inservice - Teacher	0.108	0.295	-0.104
Principals' leadership/Teachers' perception	0.028	-1.115	-0.056
Principals' encouragement/Teachers' perception	0.018	-0.880	0.032
Pretest score	0.796	7.217	0.288
Pretest score - squared	0.196	-3.782	-0.315
Highest degree - Principal	0.008	-5.990	0.058
Total years teaching - Principal	0.031	0.503	0.060
Total years administration - Principal	0.092	-0.257	-0.022
Math participation - Principal	-0.002	-0.447	-0.065
Math involvement - Principal	0.060	-0.746	-0.044
Instructional leadership - Principal	0.015	8.469	-0.022
Attitudes:			
Well-planned - Principal	-0.025	-2.117	0.078
Well-planned - Teacher	-0.007	-0.046	0.002
Active leadership - Principal	-0.097	2.222	0.086
Active leadership - Teacher	-0.056	-0.675	0.056
Work well together - Principal	-0.051	3.159	0.057
Work well together - Teacher	0.008	-0.029	0.001
Well-informed - Principal	-0.016	0.170	-0.002
Well-informed - Teacher	0.041	1.068	-0.041
Conflicts identified - Principal	-0.082	-1.456	0.058
Conflicts identified - Teacher	0.026	0.864	-0.055
SUM	1.5178	.5321	-.1800

Notes: β refers to the coefficients of the nonunion production function in Table 2.2. X refers to the nonunion means from Table 2.1. The changes are calculated by subtracting the nonunion value from the corresponding union value.

determinants of student achievement is measured with a number of other variables held constant (For example, district enrollment, school climate, physical violence, and community type.)[2] We supplement the results in Eberts (1982) (that is, those for administrators per student, teachers per student, teacher experience, teacher degree, teacher time in instruction, and teacher time in preparation) with similar analyses for principal experience, principal degree, and principal involvement (these estimates are omitted for brevity). Thus, considering only the impact of the differences in means shown to be related to collective bargaining, we find a net impact of only .45, about 4 percent of the average gain. Hence, the net change in student achievement resulting from union-induced changes in resources is very small--small despite a number of very substantial individual effects, since these tend to be offsetting.

Differences in Education Production Functions

In this subsection we measure the impact of differences in the educational production functions on fourth grade student achievement for union and nonunion districts. As indicated above, separate estimates of the educational production functions for union and nonunion districts are presented in Table 2.2, along with the differences in the coefficients. Over half the coefficients differ significantly between the two groups of districts, including those for race, administrators per student, teachers per student, office staff per student, teacher instruction time, teacher time spent in administrative duties, teacher degree, college math courses taken by the teacher, student pretest score, principal degree, principal experience in teaching, principal participation, principal involvement, instructional leadership by the principal, and a number of other variables related to perceptions of performance.

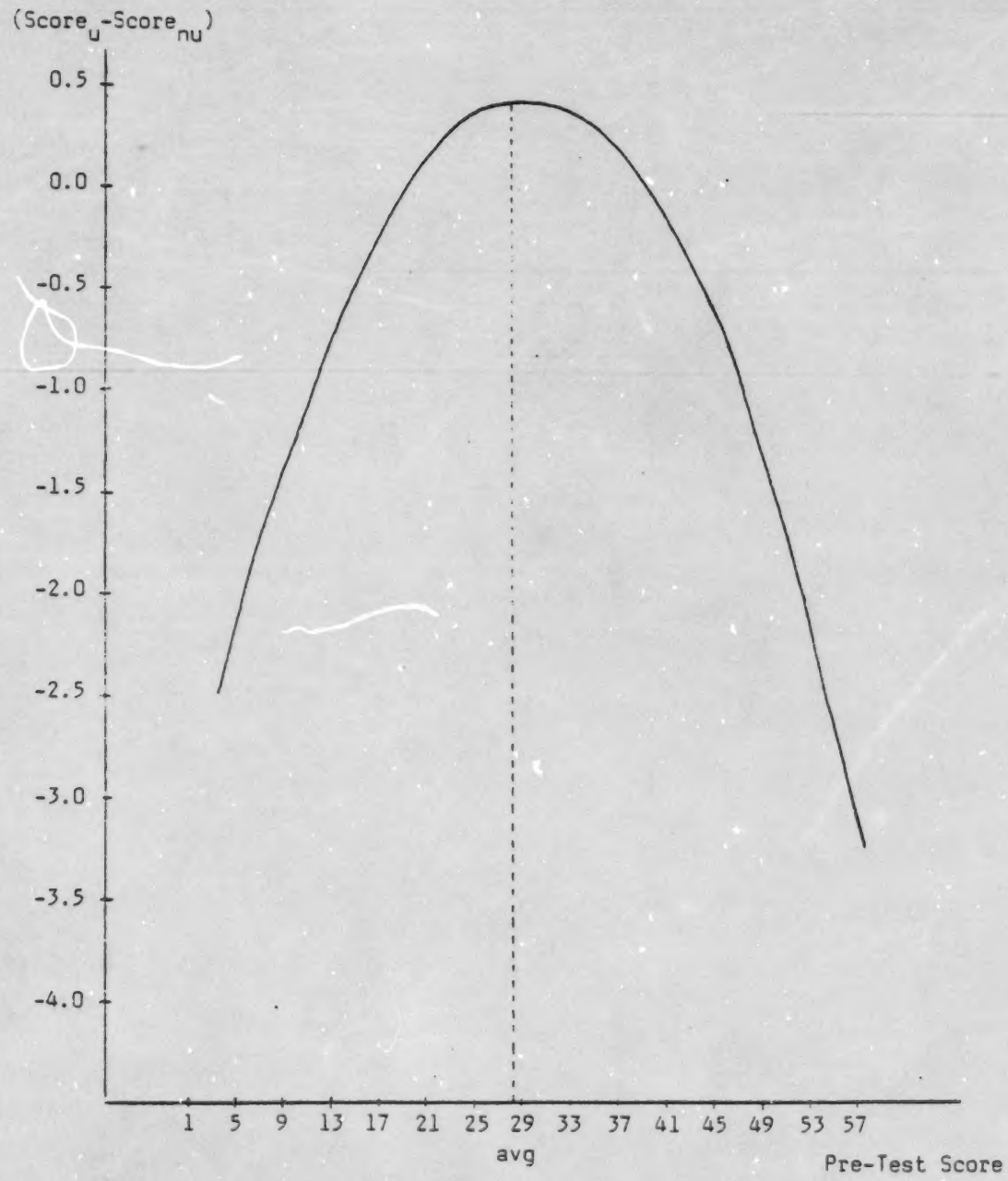
To assess the impact of these differences in the educational production functions, we multiply each difference in coefficients by the nonunion mean of the corresponding variable. These products are presented in the second column of Table 2.3, under the column heading $X\Delta\beta$. The largest positive effects are those for the pretest score, instructional leadership by the principal, and the principal's perception of how well teachers work together; the largest negative effects are those for teacher instructional time, the squared term for the pretest score, principal degree, and the principal's perception of how well-planned the school's programs are. The net impact of all the differences in coefficients is .53, about 5 percent of the average gain from pretest to posttest score. Hence, the impact of this second source of union-induced changes in student achievement is also very small--and again small despite a number of substantial individual effects.

While our emphasis in this analysis is on the overall impact of collective bargaining, we should dwell at least a moment on one set of differences revealed in Table 2.2. The coefficients for pretest score and the square of the pretest score are .713 and .0027 for nonunion districts and .971 and -.0017 for union districts. The difference by union status is statistically significant in both cases. To evaluate this difference, we compute the predicted posttest score associated with a particular pretest score. Subtracting the predicted score for a student in a nonunion district from the predicted score for a student with the same pretest score in a union district, one obtains a measure of the difference in the relationship between pretest and posttest scores in union and nonunion districts.

This difference is plotted in Figure 2.1 for a range of pretest scores. As the diagram illustrates, the difference in achievement scores is greatest for students near the average pretest score (about 29). This implies that union districts do relatively best with average students. For

Figure 2.1

Difference between Predicted Posttest Scores in Union and Nonunion Districts by Pretest Score



above-average students, union districts tend to compress test scores toward the average, as compared to what happens in nonunion districts. This obviously implies a reduction in the dispersion of posttest scores for students with above-average pretest scores. For below-average students, however, just the opposite occurs in union districts. For these students, nonunion, rather than union, districts tend to compress test scores toward the average. While we lack the intensive case study required to fully explain why the impact of collective bargaining appears to vary for different students, we speculate that the difference results from the standardization associated with collective bargaining in most industries, e.g., we already know from previous analysis reported in Eberts and Stone (1984) that organized districts with class-size restrictions in the contract are more likely to use standard classroom instruction as a uniform mode of instruction.

To pursue this point further, we calculate differences for union and nonunion districts in the use of special instructional modes and resources, using the national SDC data. These differences are presented in Table 2.4, along with the separate union and nonunion means. Students in union districts clearly have less exposure to specialized instructional modes or resources. Since specialized modes are those typically associated with students well-above, or well-below, average, these differences appear to provide one explanation for why union districts work less well for these students than for average students.

Interactive Effects

Our final component for changes in the level of student achievement attributable to collective bargaining consists of the interactions between differences in the levels of resources and in educational processes. Since

Table 2.4 Instructional Modes and Resources for Mathematics in Union and Nonunion Districts (SDC Data)

Variable Description	Means		Difference
	Union	Nonunion	
Student hours spent with math specialist, class of 7 plus	2.12	3.63	-1.51 (-6.78)
Student hours spent with math aide	1.97	5.24	-3.27 (-15.57)
Student hours spent with math tutor	.96	1.29	-.33 (-3.76)
Student hours spent in independent, programmed study	3.37	5.65	-2.28 (-8.69)

Notes: See Chapter 1 for a description of the SDC data. The t-values for the difference in the means are in parentheses.

we already know that the net impact on student achievement from each set of differences is small, the net impact resulting from interactions between the differences is likely to be even smaller. To calculate these interactions, we simply multiply the corresponding pairs of differences. These are displayed in the third column of Table 2.3, under the column heading $\Delta X \Delta \beta$. The largest positive effect is that for the pretest score; the largest negative effects are those for the teacher-student ratio, teacher math inservice training, and the square of the pretest score. The net effect of all the interactions is only -.18, about 2 percent of the average gain from the pretest to posttest score.

Overall Assessment of Fourth Grader Achievement

Our results for fourth graders document numerous and profound differences between union and nonunion districts. We find significant differences in both the levels of resources allocated to the educational process and the educational process itself. Despite this multitude of differences, however, the net effect of collective bargaining on student achievement gains (that is, the sum of the three components discussed above) is only .8, about 7 to 8 percent of the average gain from the pretest to posttest score. This apparent paradox is explained by the fact that, in the final analysis, the detailed differences attributable to collective bargaining tend to be offsetting in their effects on student achievement. Of course, for the harshest critics of collective bargaining, the surprise is that the net effect, if anything, is marginally positive, not significantly negative. We do find, however, that union districts do relatively best with average students, compressing test scores toward the average for above-average students, while dispersing scores away from the mean for below-average students.

B. Sixth Graders

Differences in Educational Inputs

Evaluation of the impact of collective bargaining on student achievement of sixth graders follows the same procedure used for fourth grade achievement. We first compute the difference in means between union and nonunion districts for the factors used in the educatinal production function. These differences, along with separate union and nonunion means are presented in Table 2.5. As was the case with fourth graders, almost all the means differ significantly for the union and nonunion districts, and the union means exceed the nonunion means for those factors identified as major determinants of student achievement, with a few exceptions. The most notable exceptions are college math courses taken by the teachers, the principal's highest degree and the principal's math involvement and instructional leadership. The net effect of the difference in each educational input on student achievement for sixth graders ($\beta\Delta X$) follows roughly the same pattern found for fourth graders. As revealed in the first column of Table 2.7, the largest positive effects are those for economic status, pretest score, and the number of college courses taken by teachers. Significantly, only teachers per student is absent from this list. The largest negative effects are very similar for fourth and sixth graders. The sum of all these individual effects is .99, or about 11 percent of the average gain from the pre- to posttest score. The difference in the magnitude of educational inputs between the two types of districts contributes slightly less to the difference in achievement (11 percent compared with 15 percent) than found for fourth graders.

TABLE 2.5: Means of Educational Inputs for Sixth Graders by Union Status (SDC Data)

VARIABLES	UNION MEANS	NONUNION MEANS	DIFFERENCE	
Intercept	1.000	1.000	0.000	
Sex (Male=1) - Student	0.502	0.502	0.000	
Race (White=1) - Student	0.776	0.756	0.020	*
Childhood experience - Student	1.027	0.986	0.041	
Parental involvement - Student	1.586	1.350	0.236	*
Economic status - Student	238.003	225.185	12.818	*
Administrators per student	0.004	0.004	0.000	
Teachers per student	0.055	0.052	0.003	*
Office staff per student	0.018	0.018	0.000	
Teacher time in instruction	4.783	5.179	-0.396	*
Teacher preparation time	1.400	1.275	0.125	*
Teacher time in administrative duties	0.786	0.638	0.148	*
Total years teaching - Teacher	11.676	10.758	0.918	*
Highest degree - Teacher	2.607	2.471	0.136	*
College math courses - Teacher	0.765	0.943	-0.178	*
Math inservice - Teacher	7.379	8.327	-0.948	*
Principals' leadership/Teachers' perception	3.483	3.397	0.086	*
Principals' encouragement/Teachers' perception	3.194	3.349	-0.155	*
Pretest score	26.939	26.019	0.920	*
Pretest score - squared	822.407	766.787	55.620	*
Highest degree - Principal	2.982	3.013	-0.031	*
Total years teaching - Principal	10.611	9.086	1.525	*
Total years administration - Principal	8.909	8.384	0.525	*
Math participation - Principal	10.100	10.509	-0.409	*
Math involvement - Principal	11.934	13.011	-1.077	*
Instructional leadership - Principal	52.664	53.988	-1.324	*
Attitudes:				
Well-planned - Principal	3.211	3.357	-0.146	*
Well-planned - Teacher	2.531	2.724	-0.193	*
Active leadership - Principal	3.059	3.118	-0.059	*
Active leadership - Teacher	2.189	2.277	-0.088	*
Work well together - Principal	3.505	3.419	0.086	*
Work well together - Teacher	2.986	3.111	-0.125	*
Well-informed - Principal	3.320	3.290	0.030	*
Well-informed - Teacher	2.207	2.336	-0.129	*
Conflicts identified - Principal	3.192	3.404	-0.212	*
Conflicts identified - Teacher	2.371	2.503	-0.132	*

*Significant at the 0.5 level

Differences in Educational Production Functions

Union and nonunion districts may also differ with respect to the educational production functions. Separate estimates of these functions for sixth grade math scores are presented in Table 2.6. One-third of the coefficients differ significantly different from those found for fourth graders, five were in common with fourth grade estimates, including teacher/student ratio, teacher time spent in instruction, college math courses taken by teachers, highest degree attained by principals, and the principal's involvement in math curriculum planning. The signs of the differences in the two sets of coefficients common to both grades were the same except for teacher/student ratio.

The impact of these differences in the educational production functions can be assessed by multiplying each difference in coefficients by the nonunion mean of the corresponding variable ($X\Delta\beta$). These products are listed in the second column of Table 2.7. The largest positive impact includes the intercept, teacher/student ratio, and various attitudes of principals and teachers. The largest negative effects are those for the time teachers spend in instruction, highest degree attained by teacher, pretest score, and instructional leadership. The net impact of all the differences in coefficients is 1.059, or 11 percent of the average gain in achievement. This second source of union-induced effects is of roughly the same magnitude as that change which results from a difference in attributes.

The negative effect associated with the pretest score and the lack of significance in the difference in pretest squared marks a major difference between the fourth grade and the sixth grade results. For fourth graders, the significant difference found for both pretest and pretest-squared resulted in a nonlinear relationship between the difference in predicted posttest scores between union and nonunion districts for students with the

TABLE 2.6: Educational Production Functions for Sixth Graders by Union Status

VARIABLES	COEFFICIENTS UNION		NONUNION		DIFFERENCE	
Intercept	5.347		-7.20		12,552	*
Sex (Male=1) - Student	-1.767	*	-1.41	*	-0.352	
Race (White=1) - Student	0.719	*	0.79		-0.071	
Childhood experience - Student	0.081		-0.08		0.164	
Parental involvement - Student	0.000		0.36	*	-0.360	*
Economic status - Student	0.020	*	0.02	*	0.002	
Administrators per student	82.863		-110.43		193.297	
Teachers per student	-12.551		-53.54	*	40.993	*
Office staff per student	-29.578	*	5.80		-35.381	
Teacher time in instruction	-0.044		0.59	*	-0.638	*
Teacher preparation time	0.324		0.39		-0.069	
Teacher time in administrative duties	0.098		0.54		-0.442	
Total years teaching - Teacher	0.046	*	0.01		0.036	
Highest degree - Teacher	-0.392		0.05		-0.438	
College math courses - Teacher	0.066		-0.56	*	0.625	*
Math inservice - Teacher	0.033	*	-0.03	*	0.067	*
Principals' leadership/Teachers' perception	-0.094		-0.15		0.055	
Principals' encouragement/Teachers' perception	0.159		0.16		-0.003	
Pretest score	1.039	*	1.16	*	-0.120	
Pretest score - squared	-0.001		-0.00		0.001	
Highest degree - Principal	-0.509		3.92	*	-4.425	*
Total years teaching - Principal	-0.034		-0.05		0.014	
Total years administration - Principal	0.131	*	0.10	*	0.030	
Math participation - Principal	-0.055	*	-0.04		-0.015	
Math involvement - Principal	0.058	*	-0.04		-0.096	*
Instructional leadership - Principal	-0.070	*	0.01		-0.085	
Attitudes:						
Well-planned - Principal	0.325		-0.36		0.688	
Well-planned - Teacher	0.074		0.81	*	-0.732	*
Active leadership - Principal	0.555	*	-0.71	*	1.261	*
Active leadership - Teacher	0.141		-0.34		0.479	*
Work well together - Principal	-0.256		-0.49		0.236	
Work well together - Teacher	0.262		-0.75	*	1.009	*
Well-informed - Principal	-0.478		0.31		-0.787	
Well-informed - Teacher	0.033		0.25		-0.222	
Conflicts identified - Principal	1.072	*	0.29		0.785	
Conflicts identified - Teacher	-0.487	*	-0.23		-0.261	
R^2	.60		.65			
No. of Observations	5662		3350			

*Significant at the 0.5 level

TABLE 2.7: Effects on Six Grade Student Achievement of Differences Between Union and Nonunion Districts in Education Inputs and Educational Production Functions

VARIABLES	$\beta\Delta X$	$\beta\Delta X$	$\beta\Delta X$
Intercept	0.00000	12.552	0.00000
Sex (Male=1) - Student	0.00000	-0.177	0.00000
Race (White=1) - Student	0.01580	-0.054	-0.00142
Childhood experience - Student	-0.00340	0.162	0.00672
Parental involvement - Student	0.08496	-0.486	-0.08496
Economic status - Student	0.23072	0.450	0.02564
Administrators per student	0.00000	0.773	0.00000
Teachers per student	-0.16063	2.132	0.12298
Office staff per student	0.00000	-0.637	0.00000
Teacher time in instruction	-0.23522	-3.304	0.25265
Teacher preparation time	0.04912	-0.088	-0.00862
Teacher time in administrative duties	0.07992	-0.282	-0.06542
Total years teaching - Teacher	0.00918	0.387	0.03305
Highest degree - Teacher	0.00626	-1.082	-0.05957
College math courses - Teacher	0.09950	0.589	-0.11125
Math inservice - Teacher	0.03223	0.558	-0.06352
Principals' leadership/Teachers' perception	-0.01281	0.187	0.00473
Principals' encouragement/Teachers' perception	-0.02511	-0.010	0.00047
Pretest score	1.06628	-3.122	-0.11040
Pretest score - squared	-0.11124	0.767	0.05562
Highest degree - Principal	-0.12140	-13.333	0.13717
Total years teaching - Principal	-0.07320	0.127	0.02135
Total years administration - Principal	0.05302	0.252	0.01575
Math participation - Principal	0.01636	-0.158	0.00613
Math involvement - Principal	0.04093	1.249	-0.10339
Instructional leadership - Principal	-0.01986	-4.589	0.11254
Attitudes:			
Well-planned - Principal	0.05300	2.310	-0.10045
Well-planned - Teacher	-0.15556	-1.994	0.14128
Active leadership - Principal	0.04165	3.932	-0.07440
Active leadership - Teacher	0.02974	1.091	-0.04215
Work well together - Principal	-0.04231	0.807	0.02030
Work well together - Teacher	0.09337	3.139	-0.12612
Well-informed - Principal	0.00927	-2.589	-0.02361
Well-informed - Teacher	-0.03289	-0.519	0.02864
Conflicts identified - Principal	-0.06084	2.672	-0.16642
Conflicts identified - Teacher	0.02983	-0.653	0.03445
SUM	.987	1.059	-.1222

Notes: β refers to the coefficients of the nonunion production function in Table 2.2. X refers to the nonunion means from Table 2.1. The changes are calculated by subtracting the nonunion value from the corresponding union value.

same pretest score. For sixth graders, the lack of a significant difference in the pretest-score squared makes for a linear relationship between the difference in predicted posttest scores and the pretest scores. This relationship is plotted in Figure 2.2 for a relevant range of pretest scores. Notice that students with pretest scores below the average (about 27) do better in union districts than nonunion districts, whereas high-achieving students do better in nonunion districts. For fourth graders we found that both below and above average students perform better in nonunion districts. The difference at the sixth grade level for below average students does not appear to be related to a difference in teaching modes or other resources, since these are similar to those on Table 2.4 for fourth graders. One possibility is that the better performance of below average students is simply a "catch-up" related to previous under-performance.

Interactive Effects

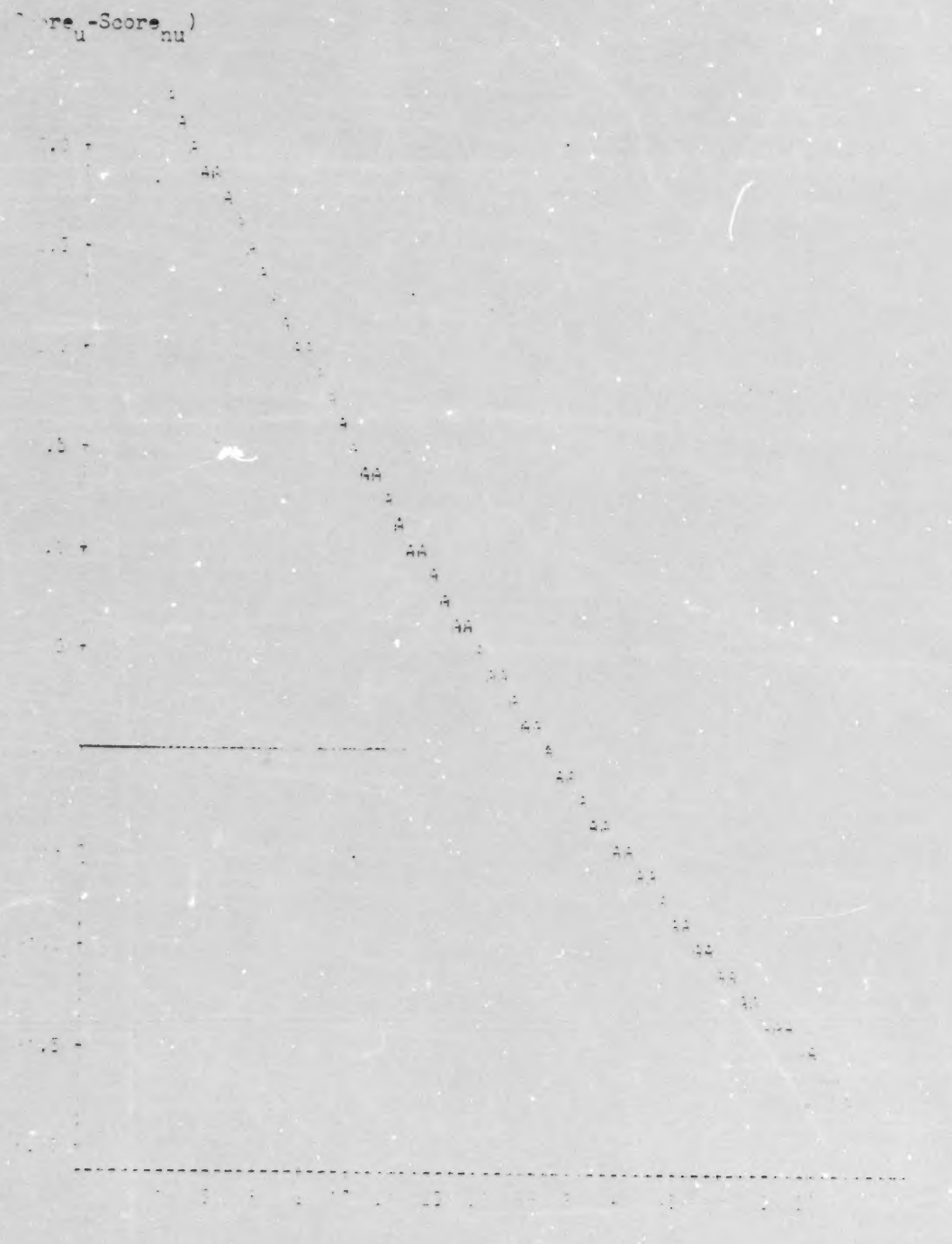
The interactive effects consist of the differences in the levels of resources and the differences in educational processes. To calculate these interactions, the corresponding pairs of differences in the first and second columns of Table 2.7 are multiplied together and displayed in the third column of the same table. The largest positive effect is that for instructional time; the largest negative impacts are associated with attitudes of principals and teachers and the pretest score. The net effect of all these interactions is relatively small, -.122, which amounts to only 1 percent of the average gain in sixth grade math achievement.

Overall Assessment of Sixth Grader Achievement

The sum of the three components equals 1.92, or 21 percent of the average gain in achievement. In doing our assessment of sixth grade

FIGURE 2.2

Difference between Predicted Posttest Scores in Union and Nonunion Districts by Pretest Score for Sixth Graders



achievements, we did not eliminate the variables not directly related to collective bargaining as we did in the fourth grade assessment. To compare results for the two grades we used the original overall assessment for fourth grade, 1.87 or 18 percent calculated before the unrelated variables were eliminated. The results are strikingly similar. In this respect, results for sixth graders support our results for fourth graders. Since fourth and sixth grades are typically in the same school, and thus subjected to the same differences in resources and administrative behavior, the similarity in results are not surprising.

There are some marked differences in results, however, and these are associated primarily with behavior in the classroom. Unlike the results for forth graders, we found a distinct delineation in the effects of unions on high and low achievers. Low achievers perform better in union districts whereas high achievers perform better in nonunion districts. Without a detailed analysis of the classroom, the only explanation we can offer at this time is that differences in curriculum and classroom organization as well as differences in the necessity of certain types of instruction may attribute to the difference in results.

II. Costs, Student Achievement, and Collective Bargaining

We found in the previous section that although collective bargaining significantly affects major inputs in the educational process, the effects tend to be offsetting, so that the net difference in student achievement gains between union and nonunion schools is neglible. Or, stating the same result in a slightly different way, after we consider differences in the level and quality of educational resources as well as differences in the productivity of these factors, union and nonunion schools appear on average to be about equally effective.

Having found little difference in overall quality between union and nonunion schools, we now address the issue of whether union and nonunion schools produce these achievement gains at the same cost. We partially answered this question in previous analysis by considering the relationship between bargaining activity and the level of district expenditures. As reported in Eberts and Stone (1984), we found that the appearance of a reduction-in-force provision increased per pupil district expenditures, while a loss of the provision decreased expenditures. In addition, a positive correlation was found between the number of provisions in the contract and the district's total operating expenditures per pupil. In this section, we calculate the overall effect of collective bargaining on the cost of education, holding constant both the quantity and the quality of education provided.

The literature on the subject of teacher collective bargaining and district expenditures holds mixed views. Gallagher (1979) estimates that the operating budget in union districts is approximately 9 percent larger operating than nonunion districts, when everything else is the same. Hall and Carroll (1975) challenge Gallagher's position and conclude that higher teacher salaries negotiated in union districts are completely offset by larger class sizes, resulting in no significant difference in total operating expenditures between the two district types. Chambers (1977) also finds that collective bargaining reallocates resources within the district without a significant increase in total operating expenditures.

None of these studies, or even our own previous analysis, deals directly with the issue of overall union-nonunion cost differentials with the quality of education held constant. To do this, we estimate an expenditure equation which specifies district operating expenditures per pupil as a function of variables that reflect the quality of education, community

preferences and fiscal capacity, the size of the district, and urban and geographical characteristics.

The quality of education is measured by the district average fourth grade scores on the math test used in the previous section and in Chapter 1. An alternative measure of educational quality would be the difference between the posttest and pretest scores. Since the difference in scores is considered to result from the flow of school-based educational services, the annual operating budget of districts should reflect the cost of providing these services. The level of test scores, however, is found to be a better predictor of district budgets than the change in scores, presumably due to the cumulative nature of the educational process.

We attempt to capture some of the community preferences for educational services by including the percentage of parents in the district who attended college. One would expect the level of parents' education to be positively correlated with the value placed on their children's education. The district's fiscal capacity is measured by the average income of families within the district. The assessed value of property within the district would be a better measure of fiscal capacity since the majority of district revenue comes from property taxes. However, assessed valuation was not available in our sample, so we used family income since it is highly correlated with property values. The percentage of families who own their home is also included to account for variations in the link between property values and family income, since tax illusion may exist among renters.

Districts in our sample are drawn from different parts of the country and from different community settings, hence there may be wide variations in costs attributable to differences in labor and material costs and to differences in the students who attend these schools. To account for regional cost differences, the location of districts is identified by ten

dummy variables, each representing a different geographical region. Five city types are considered by including dummy variables that indicate whether the district is located in a large city, suburb, middle size city, town, or rural area. The size of the district may also affect operating costs. District enrollment, entered in quadratic form, accounts for the possibility of economies of scale in the operation of schools and other effects one might associate district size.

The difference in district expenditures per pupil attributable to collective bargaining is estimated using a dummy variable equaling one if teachers in the district are covered by a collective bargaining agreement, and equaling zero if they are not. Staffing ratios and other district resources are not included in the equation so that both direct and indirect effects of collective bargaining on costs will be captured by the union dummy. Including staffing ratios would presumably bias downward the coefficient on the dummy variable, since collective bargaining has been shown to increase these ratios.

A. Effects of Collective Bargaining on Operating Costs

Estimates of the direct and indirect effects of collective bargaining on the costs of education, displayed in Table 2.8, show that teacher collective bargaining increased operating costs per student by $198, or about 15 percent for our national sample of districts.[3] This estimate is close to what Gallagher found for a more limited sample of school districts. The estimate also lies in the middle of the range of estimates we reported in Eberts and Stone (1984) for the effect of bargaining activity on the allocation of budget expenditures. More interesting, perhaps, is that the 15 percent estimate falls in the middle of the estimates obtained by Baugh and Stone (1982a) for the effect of collective bargaining on teacher salaries.

Table 2.8: ESTIMATES OF THE EFFECT OF TEACHER COLLECTIVE BARGAINING AND STUDENT ACHIEVEMENT ON DISTRICT OPERATING EXPENDITURES (SDC Data)

Variable Description	Mean	Coefficient	t-statistic
1) Intercept		852.82	3.81
2) If district covered by collective bargaining value = 1	0.65	198.00	2.94
3) Average district score on on standardized math test	29.53	15.19	2.00
4) Percentage of students' parents attended college	0.28	-387.05	1.71
5) Average family income in district	14845.95	0.02	2.10
6) Percentage of families who own their home	0.67	-208.82	1.35
7) Percentage of white students in district	0.83	-312.72	2.66
8) Composite index of school climate	8.66	8.58	0.58
9) District enrollment (/1000)	23.68	0.003	0.81
10) District enrollment squared	4159.30	0.000	0.02
11) City Type: over 200000	0.15	-109.65	0.89
50000-200000	0.15	-27.28	0.31
under 50000	0.29	-58.73	0.89
suburb	0.10	164.77	1.61
12) Geographical region:			
New England	0.09	157.41	1.25
Metropolitan Northeast	0.11	582.90	4.77
Mid-Atlantic	0.10	223.82	2.02
Northeast	0.13	193.47	1.68
South Central	0.12	-62.05	0.59
Central Midwest	0.10	195.90	1.79
North Central	0.10	264.84	2.31
Pacific Southwest	0.08	311.39	2.57
Pacific Northwest	0.08	667.00	5.38

R-squared: 0.46 F-ratio: 7.02; Number of observations: 205

Dependent variable: total district expenditures per pupil, 1976-77

Note: Rural districts are the excluded city type; districts in the Southeast are the excluded geographical region. See Chapter 1 for a description of the SDC data.

Since our estimate of the impact of collective bargaining on costs is insensitive to a number of alternative specifications (e.g., to specifying separate equations for large and small districts, or for large and small cities), we conclude with some confidence that districts with collective bargaining agreements spend about 15 percent more than districts without such agreements to achieve the same level of student achievement.

B. Other Factors Affecting Annual Operating Costs

Although the impact of collective bargaining on district operating costs per pupil is the primary concern of this section, results for some of the other variables are also interesting. Aside from the coefficients associated with city type and geographic location of the school districts, only three additional variables have coefficients that are statistically significant at the 5 percent level. The quality of education, as measured by the district average of student test scores in math, is positively related to per pupil operating costs. Estimates of the educational production function reported in Chapter 1 show that the experience levels of teachers and principals and the teacher-student ratio are positively related to student achievement gains. These inputs are costly in that more experienced staff receive higher salaries and larger staffing ratios call for larger personnel expenditures. Thus, one would expect increases in quality to increase per pupil costs.

The fiscal capacity of school districts is related to average family income. Our estimates indicate that for every 100 dollar increase in family income, districts spend an extra two dollars per pupil in total operating expenses. Operating budgets also differ depending upon the characteristics of students in the district. Districts with an above-average percentage of white students provide the same quality of education at lower costs than

districts with a below-average percentage. Much of this cost differential may reflect the number of special programs for underprivileged students. Since differences for districts in large cities are already accounted for, the cost differential associated with the percentage of white students does not appear to be the result of the increased cost of operating schools in large metropolitan areas.

III. Conclusion

In this chapter, we attempted to measure the impact of collective bargaining on both the level and cost of student achievement. Our results indicate that union and nonunion schools appear, on average, to be about equally effective in producing gains in student achievement, although the way in which the gains are produced differ significantly in a number of respects. Union districts, for example, appear to work best for students near the average, and less well for students well-above or below average. We ascribe this result to the greater exposure of students in nonunion districts to specialized instructional modes and resources. Our results for district operating costs indicate that districts with collective bargaining agreements spend, on average, about 15 percent more than districts without such agreements to produce the same level of student achievement. This figure falls in line with our previous estimates of the impact of collective bargaining on salaries and on the allocation of district expenditures.

FOOTNOTES

[1]For an equation of the type

$$y = a + bx$$

any discrete change in y can be approximately measured by the sum of $b\Delta x$, $x\Delta b$, and $\Delta b\Delta x$. For our analysis in this chapter, we use the coefficients of the nonunion production function as initial coefficients and the means of the variables for the nonunion districts as initial values for the variables. The changes are then measured by subtracting the nonunion value from the corresponding union value.

[2]The table displaying the effect of collective bargaining on other factors is found in Appendix A.

[3]The estimate of 15 percent is obtained by constraining the average pretest score to be the same for both union and nonunion districts. Pre-test scores of union districts, however, are 1.12 points higher than the scores in nonunion districts. Based on the value of the coefficient associated with the pretest shown in Table 2.4, this difference accounts for an increase of $17 per pupil in expenditures of union districts, a percentage increase of 1 to 2 percent. The gain in student test scores is not statistically different for the union and nonunion districts, however. When gains, rather than levels, are entered into the expenditure equation, the union-nonunion cost differential turns out to be 14 percent. Thus, the cost estimate is not sensitive to the way in which the quality of education is measured.

APPENDIX A.2

Regressions for Teacher Participation and Contract Status (SDC data)

Dependent \ Explanatory	PARTICIPATION: Collective Bargaining	PARTICIPATION: Student Assignment	PARTICIPATION: Teacher Assignment	PARTICIPATION: Planning Course Content	PARTICIPATION: Promoting Community Interaction	SALARIES: Teacher Contract	SALARIES: Teacher Supplementary	SALARIES: Principal Contract	TEACHER CHARACTERISTICS: Experience	TEACHER CHARACTERISTICS: Education	TEACHER CHARACTERISTICS: Importance Placed on Participation***	F	R^2
RESOURCES (PER STUDENT)													
Administrators	.179	.026	.045	.046	-.040	.060		-.174				15.16	.06
	(2.23)**	(.91)	(1.41)	(1.56)	(1.32)	(1.52)		(5.38)					
Clerical and Aides	-1.21	-.281	.145	-.300	.326	-.097		1.26				22.01	.09
	(2.65)	(1.70)	(.78)	(1.71)	(1.81)	(.42)		(7.21)					
Teachers	5.24	.242	-.546	-.330	-.068	..418		.371				55.54	.20
	(12.47)	(1.60)	(3.20)	(2.06)	(.415)	(1.96)		(2.14)					
TEACHER PARTICIPATION													
Student Assignment	.050	/									.248	29.72	.08
	(1.13)										(13.68)		
Teacher Assignment	.059		/								.176	26.21	.07
	(1.72)										(10.80)		
Planning Courses	-.017			/							.289	21.23	.06
	(.404)										(9.76)		
Community Interaction	-.062				/						.182	25.61	.07
	(1.52)										(10.46)		
SALARIES													
Teacher Contract	.589					/			.060	.565		223.26	.50
	(20.75)								(33.89)	(21.26)			
Teacher Supplementary	-.117						/		-.010	.169		4.04	.01
	(1.99)								(2.68)	(2.91)			
Principal Contract	1.09							/				230.44	.38
	(25.39)												
TEACHER CHARACTERISTICS													
Experience	1.64								/			12.22	.03
	(5.80)												
Education	.098									/		14.29	.03
	(5.21)												
Length of Day	-.110					.067	.016					3.20	.21
	(1.82)					(2.38)	(1.11)						

* In order to conserve space, certain exogenous variables (District Enrollment, School Climate, Physical Violence, and Community Type) have been omitted from the Table. The estimates of these coefficients are available from the author upon request.

** T-Statistics in parentheses.

*** The specific policy area corresponds to the dependent variable.

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